

# **Incidence of camel Trypanosomosis in camel herds restricted to Nyala rural suburbs, South Darfur state -Sudan**

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## ***Dedication***

*This study is dedicated to my Father, who reserved no effort to get me where I am now. It is also dedicated to my Mother, my brothers, sisters and all members of my family who all supported and assisted until this work was finalized.*

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## Abstract

This study was conducted in Nyala locality, where a group of nomads were camping being forced to stay in one place due to the ongoing conflict. The main origins of these groups are in North Darfur state who migrated to the South Darfur state after the conflict.

The aim of this study is to provide an updated data about camel Trypanosomiasis in the area, determine the seasonality of the disease and reflect the war effect in the life of nomads and health of their animals.

The stock under the study is 100 head of camel composed of 66 females and 34 males, of different age groups. Samples were collected from these herds for 6 months (February –July), the total samples collected were 1200 during this period, the general health of these camels and the presence of *T.evansi* in the blood of each individual was recorded. Blood smears and Haematocrit Centrifugation Technique were used as diagnostic methods to detect *T.evansi* in the blood, Packed Cell Volume were recorded for infected and non- infected animals.

It was clear that in infected animals PCV decline at the appearance of the parasite in the blood. The infection rates in rainy season (June – July) was higher than dry season (February – May). The infection rate 28%, the infection in the males 16% are higher than the females 12% , because males are used in

search of water and cutting trees for food and fuel, this takes the males to contact with fly areas. Camels owners have good knowledge about Trypanosomiasis in thier camels and depend on traditional practice of change in urine odour in diagnosis of the disease but their knowledge about treatment and prevention is weak.

Infected animals showed poor body condition, rough coats, emaciation, pale mucous membrane, enlargement of cervical lymph nodes, nervous signs and and some times abortion. All infected animals are treated and there were no relapses during the observation period showing little possibility of drug resistance or re-infection.

It is recommended that consideration to the traditional knowledge in diagnosis are necessary, Extension campaigns to advice owners on the use of drugs are important. Confinement of herds due to conflict appeared to adversely affect herd health, so conflict resolution should be encouraged to resume the natural migratory system.

The owners attitude and general observations during this study indicated the increase of incidence of some diseases, particularly the chronic wasting parasitism resulting from over crowding and limited nutritional resources.

## Introduction

South Darfur state is situated in the western part of the Sudan, bordered by West Kordofan to the East, North Darfur to the North and West Bahr Alghazal state to the South, West Darfur to the West and it shares international borders with the Republic of Central Africa and Chad to the South and West respectively.

It is divided into nine localities: Nyala, Shearia, Adeila, Buram, Tulus, Eddelferran, Reheid, Alberdi and Kass. Nyala town is the capital of the state.

The climate varies from high rainfall woodland savannah (400-1300mm) in the southern parts to low rainfall savannah (300-800mm) in the northern parts. The high rainfall savannah is covered with broad-leaved wooded savannah trees and grasses.

In March to June (summer) the climate is dry and hot while in July-October (rainy season) it is wet and cool and during November to February (winter) the climate is dry and cool. The ambient temperature in the northern parts varies from 35°C to 10°C and in the southern parts from 40°C to 15.9°C (Suliman 2003).

The northern parts of the state are always affected by overgrazing in the rainy season due to high density of livestock.

The majority of the residents of the state are either pastoralists or agro-pastoralists. Livestock species include cattle, sheep, goats, camels, horses, dogs and donkeys. In the northern and

eastern parts of the state there are more sheep and camels compared to cattle which are confined to the southern parts.

Animals distribution has changed due to conflict and desertification. Camels in the state are estimated to be 74950 (Anon 2005) have special importance in the life of the nomads in this area for milk, meat and transport. The nomadic system depends on camels and is characterized by migration of pastoralists with animals for longer distances which are only beared by this animal species. At the begging of the rainy season they migrate from South to the North, to neighbouring states towards the rainy season grazing areas (*Makhraf*). Before the end of the rainy season they move to the southern parts of the state or other states and even cross the international borders to dry season grazing areas (*Masiaf*) looking for water and pasture.

The war and insecurity have compelled camels to stay in the South in fly infested areas for longer times. Camels are principally affected by Trypanosoma evansi. In the acute form of the disease, progressive weakness and loss of condition are noticeable. The coat becomes rough and staring, the animals tend to stumble and pregnant females abort. There is recurrent fever and there may be petechiae on the visible mucous membranes (Stephen 1986) Milder cases develop relapsing parasitaemia with or without pyrexia (Mahmoud and Osman 1979) and death generally occurs within 2-3 years after the

disease sets in, (Manual of Tropical Veterinary Parasitology 1989).

**Objectives of the study:**

Camels health problems had been neglected in South Darfur particularly during the civil unrest in spite of their importance in supporting the community socio economy.

This study is planned to address one of the important camel diseases, trypanosomosis as an example of health threats due to confinement enforced by insecurity.

The specific objectives are:

1. To provide recent data on the incidence of camel trypanosomosis in a selected area of South Darfur.
2. To determine the seasonality of the disease
3. To reflect the effect of civil unrest on camels general health.

## **Chapter one**

### **Literature review**

#### **1.1The Livestock Resources in Sudan:**

The Sudan is the largest African country with livestock estimated to be 136 million of which 40 million cattle, 50 million sheep, 42,5 million goats, 4 million camels and 0,5 million horses (Anon 2005) in addition to wildlife and considerable numbers of donkeys, dogs and cats. In spite of the large numbers of livestock the out come is low in production and productivity.

Livestock is reared in all the 25 states of Sudan although camels are not reared in some Southern states however Blue Nile, Elgedaref, Elgazira, the greater Darfur, greater Kordofan White Nile and Sinnar states account for 56% of Sudan's 52,504,000 tropical livestock units (TLU) (The Ministry of Animal Resources and Fisheries Sudan ,MOARF 2002).

Livestock generates 20% of the national foreign exchange earnings, however after the discovery of oil, this condition has declined to below 8%. Livestock production in Sudan is predominately pastoral and a significant proportion of livestock population is owned and managed by this sector. However, export demand led production particularly of sheep and the growth in demand for local consumption of red meat to gain

importance in the agro-pastoral sector, by those who invest in livestock (Animal Services Resources Company 1999).

Sudan is probably the leading livestock exporting country in the region of East Africa in the past few years. Livestock and meat exports from Sudan are channelled through four routes: nearly all live sheep and goats (and occasionally racing camels) are exported through Port Sudan, chilled red meat is exported by air from Khartoum and occasionally from Nyala to various destinations (FAO,1997). Live camel export to Egypt is a cross-border operation through Dongnla, camel export to Libya is also a cross-border operation but this is considered unofficial.

Despite the conflict in Darfur export earnings from livestock for the first two quarters of (2004) were closed to these of (2003). Livestock authorities in Sudan continuously search for new markets and recent agreement with Egypt will boost chilled frozen beef or live cattle from Sudan (Bank of Sudan 2004).

## **1.2 Livestock in Darfur:**

The Ministry of Animal Resources and Fisheries (MOARF 2002) showed that 18% of Sudan Tropical Livestock Units (TLU) is from greater Darfur region. With greater Kordofan, the two regions account for one-third of Sudan total livestock resources. Livestock species in Darfur include camels, cattle, donkey, goats, horses and sheep (Table1).



Table (1) :Estimates of the livestock population in Darfur (2007):

State	Cattle	Sheep	Goats	Camels	Total
North Darfur	499.745	6.889.233	3.100.794	1.582.390	12.072.162
South Darfur	4.940.385	4.180.694	3.514.713	113.618	12.749.410
West Darfur	3.813.671	3.610.200	3.360.285	299.443	11.083.599
Total	9.253.801	14.680.127	9.975.792	1.995451	<b>35.905.171</b>

Source: PACE/ Ministry of Animal Resources / Sudan (2007).

According to (MOARF 2002) Darfur accounts for 21% of the cattle, 22% of the sheep and goats, 24% of the camel, 31% of the donkeys and 63% of horses in Sudan. South Darfur state is one of the richest states in animal resources in the Sudan, livestock population being estimated to be 11million consisting of 3,9 million cattle, 3,6 million sheep, 2,9million goats, 53500 donkeys 30700 horses and 8700 camels (Anon 2004).

### **1.3Livestock migration patterns in Darfur:**

In Darfur the cattle rearing (*Baggara*) and camel rearing (*Abbala*), main pastoral groups are traditionally nomadic but are increasingly becoming agro-pastoralists.

The livestock migratory routes of both groups follow a general North (wet season), South, Southwest (dry season) directions. Few groups also move from Northwest to Northeast direction. The *Baggara* move South to the Bahr Elarab River and in some cases enter the Central African Republic during the dry season. In the wet season they return to Adila, Eddaien and Nyala with some groups moving as far North as South of Elfasher town or Westwards into North and South Kordofan.

The dry season migration of *Abbala* is towards West or East of Jabel Mera Mountains, some *Abbala* reach Wadihawar and others move as far North as Elatrun Oasis in the Sahara desert. Cattle and camel swap grazing areas during the dry and wet seasons. The dry season grazing areas for camels become the wet season grazing areas for cattle, when camel migrate further

North, the wet season grazing areas for cattle become the dry season grazing reserves for camels as cattle move further South in the dry season (Al Massar Charity Organization for Nomads and Environment Conservation, MONEC, 2003).

## **1.4 The impact of the conflict on the livestock sector in Darfur:**

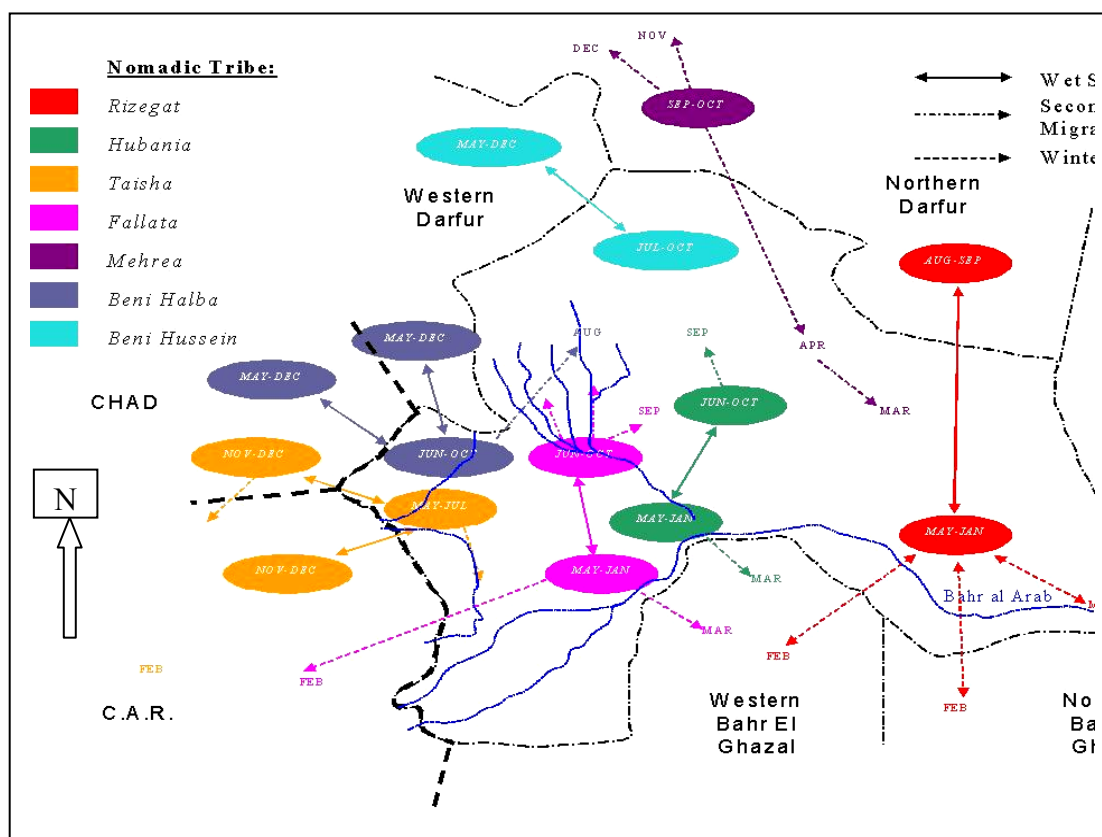
The livestock economy of Darfur has been immensely affected by the current conflict, the decline in livestock production is not surprising given the death of tens of thousands of people.

### **1.4 .1 Changes in livestock migration patterns:**

Camels and sheep belonging to the *Abbalas* were confined South of the Jebal Mara Mountains during the Missions visit, during the wet season (July to October) camel herds and sheep used to migrate further North up to Gizu, and Wadihawr to the Southern fringes of the Sahara desert. Cattle belong to the *Baggara* have been confined around the railway line close to Nyala town. While most of the restricted areas are under the control of the Sudan Liberation Army (SLA), some areas have become inaccessible to pastoralists because of banditry and attacks and counter attacks between various ethnic groups.

This has resulted in the concentration of pastoral livestock in the dry season reserves at a time when livestock should have been in the wet season grazing reserves. The conflict in Darfur has directly impacted production in term of farming and

livestock production both of which spiralled down and almost collapsed (MONEC 2003).



Map (1) Livestock migratory routes in South Darfur State (Web site: Almassar)

## 1.5 Camel farming in Sudan:

Camel is the common name for large humped, long-necked even-toed ungulates comprising the mammalian genus *Camelus* of *Camelidae* family. There are two distinct species of camels, the Dromedary and *Bactrian* camel, *Camelus dromedaries*, which has a single hump and *Bactrian* camel, *Camelus bactrian* which has two humps (Yagil 1985)

Over the past few decades camels have begun to regain recognition for their food-producing potential in arid and semi-arid areas of Sudan. After having been dismissed as uneconomical by the Sudanese government their vital role in supporting human population in some of the poorest frequently drought-stricken areas of the world has now been widely acknowledged (Salih, 1988).

Sudan has the second largest camel population in the world estimated at nearly 3,200,000 (FAO, 2004) and the country is home to some of the most well-known camel nomads. The Kababish, Shukria, Hadendowa and other tribal groups in Sudan breed distinctive types of camels (Mason and Maule 1960).

The camel (*Camelus dromedaries*) is an important livestock species uniquely adapted to hot arid environments. It is most numerous in the arid areas of Africa particularly in the arid low lands of Eastern Africa namely Somalia, Sudan, Ethiopia, Kenya and Djibouti with approximately 11,5 million animals in this

region, representing over 80% of the African and two thirds of the world camel population (Schwartz ,1992)

Geographically the camel is distributed throughout the tropical and subtropical zones of North Africa, western Asia and North West India. The limits of its natural distribution are determined by wet climates and presence of the tsetse fly (Wilson, 1984). The camel is the ideal domestic animal in deserts with long dry, hot period of eight months or more and scarce, erratic annual rainfalls between 50 and 550 mm. The camel is suitable for several purposes for which its role is essential, where it is used as beast of burden for transporting goods and people as well as for its owners. The camels meat, wool and leather are also widely utilized (Wilson, 1984).

The chief role of the camel relates directly to its remarkable adaptation to extremely harsh conditions. It can flourish where no other domestic animal can survive. This exceptional ability is the result of several anatomical and physiological characteristics as a camel may go several months without drinking and under a very hot condition it may drink only every eight to ten days and lose up to 30 % of its body weight through dehydration without notable adverse signs (Wilson 1984).

## **1.6 Camel health:**

### **1.6.1 Normal condition:**

Fluctuations are commonly observed in the body temperature of the camel, which is able to adjust its own body temperature to quit its environmental temperature.

Leese (1969) indicated that the temperature is lowest at dawn and gradually increases until sunset before dropping during the night. It may vary from day to day. He gave the normal temperature at 6 a.m. as 36.4° C and at 6 p.m. as 38.1° C. Schmidt-Nielsen (1959) gave a morning temperature of 33.9° C and asserted that the higher limit is never above 40.5°C. Altman and Ditmer (1968) gave the intramuscular neck temperature of the dromedary as 35.1–39.1° C and the rectal temperature as 34.5–38.5° C. Mason (1917) gave a range of 35–38.6° C. Leese (1927 and 1969) showed that the pulse of the camel can be taken from the posterior tibial artery, with the animal in a sitting position. The medial sacral artery, near the root of the tail, could also be used. He estimated the pulse rate of a resting camel as 45–50. He observed that the normal respiration rate of the camel at rest is 5–12 per minute. A higher respiration rate is often indicative of a febrile reaction. Like the pulse rate, respiratory rates tend to be higher at noon than in the early morning.



The camel is capable of closing its nostrils and breathing through its mouth. At such times the lower lip tends to become pendulous. Occasionally the animal will puff out its cheeks during mouth breathing. Vomiting occasionally occurs in the dromedary and is not necessarily a sign of disease. Camels are nervous animals and may vomit and spit when handled. When vomiting occurs in an undisturbed animal, however, it should be regarded as a symptom of disease.

## **1.7 Major diseases of camels:**

### **1.7.1 Skin Disease:**

Camel mange is sometimes considered the most important disease of dromedaries after trypanosomosis, the only mite that infects camels being Sarcoptes scabiei var-cameli (Richard 1976). Mange is a highly contagious disease which can spread to herds, men or others associated with infected animals. The mite may be transmitted directly by contact or indirectly through objects such as saddle, harnesses, utensils, bedding and even tree trunks.

It tends to spread more quickly during cold weather when animal coats usually grow long and animals huddle together. Sarcoptic mange affects camels of all ages and sexes and is certainly more common and severe than was previously thought (Lodha 1966). The organism which is just visible to the naked

eye requires 2 or 3 weeks to multiply after which the population explodes, spreading very rapidly all over the animal body and through the herd. Infection generally starts in the head region extending through the penile sheath and the udder, the whole body may become infested within a month. Affected areas may become swollen, hardened, hairless and wrinkled especially in the hind quarter, thigh and hock joint areas. Infected foci are highly irritating forcing the animals to scratch themselves and rub against one another, or against other objects such as trees, thereby spreading the infection even further. The infection leads to loss in feeding and grazing time. Seriously affected animals are often unsightly and blood may be seen oozing out of areas traumatized by scratching and rubbing (Lodha 1966).

Camels do not suffer greatly from tick-borne diseases nonetheless few species of ticks have been isolated including Amblyomma gemma, A.varigatum, Hyaloma truncatum, H.excavatum, Rhipicephalus pulchellus, R.parvas and R.simus (Richard 1979)

### **1.7.2 Camel Pox:**

Camel pox is an ailment mainly of young camels (6 months to 2 years) caused by a virus closely related to other variola poxes (Fazil 1977). Camel pox is an infection of the skin which can also infect man. The incubation period of the disease is about 2 weeks. It is a typical pox disease showing the four usual stages of pox lesions of papules, vesicles, pustules and crusts. These

lesions are commonly observed on the head and other areas of the body with fine skin. In young camels it may be associated with diarrhoea and subsequent death of the animals. Animals recovering are immune for life, and nursing calves attain some degree of immunity through colostrum for the first few months of life.

Adult camels are generally resistant, those that become infected usually develop a benign form manifesting as oedema of head, associated with swollen lips that may become blistered. However, (Leese 1969) indicated that camel pox may become malignant, lesion spreading to any part of the body especially the areas with thin skin and occasionally the disease may be fatal.

Skin necrosis among camels may be associated with salt deficiency, once established the ulcers spread to surrounding areas and there is little spontaneous healing Fazil (1977). It is important to be differentiated from camel pox.

### **1.7.3 Internal parasites:**

On the basis of faecal and post-mortem examination, Richard (1976) estimated that 92% of the animals examined had some degree of infestation with internal parasites (80% with *Strongyloides* ova, 10% with *Strongyloides* larvae and 16% with *Trichuris* ova). Fourteen helminth species were identified on post mortem examination, the main ones being Monezia spp, Stilesia vittata, Trichuris globosus, Trichostrongylus spp.

Cysticercosis and Hydatidiosis were also found in a few cases. Leese (1969) listed the frequent occurrence of Oestrus cameli, Haemonchus longistipes and Taenia expansa were found in smaller numbers. He adds that Echinococcosis was common among camels but is of little consequence. He also went on to describe husk as a disease of camels in the Nile Delta caused by Strongylus filaria. Richard (1976) wrote that acute helminthiasis in dromedaries (gastro-intestinal parasitism) is generally associated with diarrhoea and weakness, the frequently encountered form is the chronic one with sporadic bouts of diarrhoea constipation and emaciation. There is disturbed absorption of nutrients with a resultant drop in production. Magzoub and Kasim (1978) reported Fasciola gigantica and Fasciola hepatica among camels in Sudi Arabia, where they found a higher incidence of fascioliasis (liver fluke) in animals from the Eastern region. They associated this with the conditions which are condusive to survival of the intermediate snails hosts. A very high percentage (14%) of camels imported for slaughter from Sudan to Saudi Arabia were infected with Fascioliasis.

Michael and Saleh (1977) developed slide agglutination test for the diagnosis of camel filariasis. A method found to be 86% accurate.

A few chemotherapeutic agents have been evaluated for the treatment and control of helminths. Lodha (1977) found that

90% Methridine injectable solution at 1ml /4,5kg and 4% and Morantel tartrate of 1ml/4kg live weight were very effective in the treatment of mixed infestation of Trichuris, Haemonchus Nematodius and Strongyloides in camels .

#### **1.7.4 Protozoal infections:**

Among camels, trypanosomiasis caused by Trypanosoma evansi is present in most areas where camels are found (Bremaud 1969). T.congolense is a possible cause of the disease. The organism is transmitted by Tabanus, Stomoxys, Lyperosia and Haematobia flies (Scott 1973) which are prevalent around river banks and watering points in arid zones. Tsetse flies, the main vectors of bovine Trypanosomosis, are not involved in the transmission of T.evansi to camels. Through blood samples and smear examination it was estimated by Richard (1976) that about 15% of camels in Borana (Ethiopia) were infected. An extensive account of the disease is given by Curasson (1947), but it would appear that trypanosomosis mainly occurs as a chronic (subacute) debilitating ailment, the acute form is rare. Fazil (1977) confirmed that camel trypanosomosis is a slow, wasting disease. The animal becomes thin, weak, prostrate and eventually dies. The first signs of the disease are a drop in production (milk yield) and the possibility that pregnant females abort. There is loss of appetite and the animals become very emaciated. Leese (1969) discusses the acute and subacute forms of camel trypanosomosis at some

length, indicating that the latter form may last 3 to 4 years before the animal finally succumbs. Recovery may occur in 20% of animals which are well fed, rested and managed. These animals subsequently become immune. The death of chronically affected animals is often triggered off by secondary infections, e.g. bronchopneumonia.

A tentative diagnosis of trypanosomosis may be made on the basis of clinical signs, after which camel herders are often able to summon help or rest the affected animals. Thick blood smears taken from the tip of the ear to detect the organisms are useful in confirming the disease. The best way of controlling the disease is by treatment with drugs. Two drugs have proved useful: Naganol (Suramin, Moranyl) and Quinapyramine salts (Anthrycide). It is necessary to give the correct dosage since underdosing may create resistant trypanosomes. Gatt- Rutter (1967) discussed the prevalence of protozoal infections in the camel. In all cases, however the demonstration of an organism in the blood was used to establish the presence of a disease.

Typical of the results of Sharma and Gautam (1974) who found that 13% of 191 camels randomly sampled were serologically positive when tested for Toxoplasma gondii in India. The animals were otherwise healthy, showing no clinical signs of the disease. No extensive account of protozoal diseases are available and only a brief list of the disease treated by various authors (Gatt-Rutter 1967, Richard 1979) is given here :

Leshmaniasis, coccidiosis, theileriosis, anaplasmosis sarcoidosis and toxoplasmosis. This leaves trypanosomosis to be the primary protozoal infection of camels.

### **1.7.5 Trypanosomosis:**

Trypanosoma is classified as a flagellate protozoa from the genus Trypanosoma of the family Trypanosomatidae (Soulsby 1982).

#### **1.7.5.1 Trypanosome species in Sudan:**

The principal pathogenic Trypanosoma species reported in the country include Trypanosoma congolense, T.vivax and T.brucei which affect cattle, sheep, goats, horses and donkeys and T.evansi affecting chiefly camels and rarely horses( Elkarib 1961).

#### **1.7.5.2 Trypanosomosis in the camel:**

Trypanosoma evansi, a species belonging to the sub genus Trypanozoon is the causative agent of camel trypanosomosis. It is hypothesized that Trypanosoma evansi originated from Trypanosoma brucei by adaptation to non cyclical mode of transmission and loss of the ability to undergo growth and differentiation in the fly vector (Luckins 1998) It was postulated that Camels that came into contact with tsetse flies acquired infections, and when such camels moved to non-tsetse areas, transmission was spread by other haematophagous flies. Other species of Trypanosoma, e.g. T.congolense, T.brucei, and T.vivax have also been isolated from camels in Sudan, but their

role in camel Trypanosomosis is insignificant (Mahmoud and Gray, 1980).

Camel Trypanosomosis locally known as (Guffar) was reported officially in Sudan in 1908 in Bahar ElGhazal province (Elkarib 1961). T.evansi, one of the most pathogenic and economically important parasites in dromedary camels (Soulsby 1988) occurs in different geographical areas including North Africa, Asia, India, Pakistan and South East Asia. It has also been reported in Central and South America.

T.evansi is transmitted mechanically by biting flies (Tabanidae) and affects a wide range of domestic species (Soulsby 1988).

### **1.8 Transmission and vector distribution:**

To understand the epidemiology of the disease it is very important to study the transmission of Trypanosomosis. Surveys of Tabanus in the various tropical areas have shown a definite correlation between the seasonal outbreaks of T.evansi infections and the increase in number of Tabanus during the rain (Mahmoud and Gray .1980). Surveys also revealed the existence of T.vivax outside the tsetse belt limitations (Elkarib 1961).

More than 20 different species of Tabanus have been shown experimentally to transmit T.evansi (Luckins 1998).

In the Sudan ( Lewis 1953) had identified (75) species of Tabanid flies in different locations of the country. However the efficiency of the disease transmission is dependant on the



interval between two successive feeds and intensity of the fly challenge (Luckins 1998).

Transmission by biting flies is not the sole means by which infection is perpetuated. Ingestion of meat from infected carcasses by carnivores had been reported to result in infection and in South America vampire bats were said to be of importance both as reservoir of infection and as vectors (Luckins 1998).

### **1.9 Clinical manifestation:**

T.evansi can infect variety of hosts and causes a species-specific pathology. The following descriptions are taken from the account of (Mahmoud and Gray 1980). In the camel the disease is manifested by elevation of body temperature which is directly associated with parasitaemia. Infected animals show progressive anaemia, marked depression, dullness, loss of condition and often rapid death.

Anaemia was observed to be a major clinical finding in camel Trypanosomosis (Rami *et al* 2003). Milder cases develop recurrent episodes of fever. Some camels develop oedema in their dependant parts of the body, urticaria, plaques and petechial haemorrhage in serous membranes, death finally ensues if untreated. However some may harbour trypanosomes for 2-3 years thus constituting reservoir of infection to susceptible camel and hosts. Other well documented field reports are death and abortion (Lohr *et al* 1986). Weight loss,

reduced draught power (Luckins 1998) and nervous signs like circling movement and trembling, unusual aggressiveness running aimlessly and sudden collapse in severely stressed and over worked animals were reported (Manuel 1998). At post-mortem, necrotic foci in the liver and spleen as well as generalised lymphoid tissue hyperplasia (Rottcher *et al* 1987) were reported.

### **1.10 Diagnosis:**

There are no pathognomonic signs of trypanosomiasis so laboratory diagnosis has to be carried out to confirm infection.

Traditionally this involves parasitological and serological diagnosis. Parasitological diagnosis is mainly carried out by the direct microscope examination of blood or buffy coat and/or sub-inoculation of camel blood into rodents such as mice or rats. Serological techniques, e.g. Immunofluorescent Antibody Test (IFAT), Enzyme Linked Immunosorbent Assay (ELISA) and the Card Agglutination Test for Trypanosomosis (CATT). These although sensitive, cannot distinguish current from cured infections (Luckins .1998). Definitive diagnosis of a current infection with T. evansi relies on the demonstration of the parasites in the blood or tissue fluids of infected animals.

However in camel parasites detection techniques are not always successful as the level of parasitaemia is often low and fluctuates, particularly during the chronic stage (Nantulya, 1990). The other techniques like antigen (Ag) and antibody (Ab)

detection tests themselves have inherent poor results ( Olaho-Mukani *et al* 1993).

### **1.10.1 Parasitological Methods:**

Parasitological techniques are the examination of wet, thick and thin blood films .Although these parasite detection techniques are specific, parasitological techniques have low sensitivity because a certain proportion of false negative may be recorded as parasitaemia is genenerally low and fluctuating (OIE, 1996). Another parasitological method based on the concentration of Trypanosoma in the buffy coat is the microhaematocrit centrifuge technique described by Woo (1970). The Buffy coat examination methods (Haematocrit Method ) is considered to be more sensitive and reliable than the other direct microscope examination even if parasitaemia is as low as 5 trypanosomes/ml blood, Woo (1970). It was found that thick smear examination is more sensitive than thin smear examination when parasitaemia is low in T.evansi infections (Abdalla1996).

### **1.10.2 Inoculation of laboratory animal:**

Inoculation of blood harbouring infective trypanosomes in susceptible laboratory animals is considered an efficient mean of diagnosis. Though its use is limited to some species of Trypanosoma, it should be applied under certain conditions (Kellick-kendrick 1968). Some researchers concluded that the

use of laboratory animals for diagnosis of trypanosomosis is of low value due to difficulty of handling them under field conditions and the presence of some refractory species or strains of *Trypanosoma* in addition to the long time required for getting results (Elmalik,1976).

### **1.10.3 Serological methods:**

These techniques require the demonstration of antibodies in the blood circulation, yet they neither allow easy differentiation between species nor do they guarantee that animal was infected at the particular time when the sample was collected (OIE Manual 1996). Serological tests have been developed and evaluated for diagnosis of trypanosomosis in camels.

#### **1.10.3.1 Indirect fluorescent antibody test:**

The test is used to detect trypanosome antibodies. It has proven to be a sensitive test. It has the disadvantage of that it can only be carried out in laboratories and the procedure is rather long and complicated as well as to some extent subjective (Uilenberg G,1998).

#### **1.10.3.2 Enzyme- linked immunosorbent assay:**

An immunodiagnostic method based on a direct sandwich enzyme- linked immunosorbent assay (ELISA), using monoclonal antibodies. It has been examined in a number of African laboratories for its suitability for monitoring tsetse control and eradication of trypanosomal antigens in serum samples. It have proved to be unsatisfactory with respect to

diagnostic sensitivity when compared with traditional parasitological methods such as the dark ground/phase contrast buffy-coat technique. Consequently, antigen-detection systems exploiting various others, direct, indirect and sandwich ELISA systems and sets of reagents are being developed to improve diagnosis. In addition, an existing indirect ELISA for the detection of antibodies has been improved and is being evaluated in the field in order to detect cattle that are or have been recently infected with trypanosomes (De Rebeski *et al*, 1999).

### **1.10.3.3 Card Agglutination Tests:**

It is well known for certain predominant variable trypanosomes from different areas. On this basis, a field test for the diagnosis of Gambian sleeping sickness, the Card Agglutination Test (CATT/T). brucei gambiense was developed at laboratory of Serology, Institute of Tropical Medicine, Antwerp, for the diagnosis of T.evansi infection, a similar test system has been developed, CATT/T.evansi, proved to be highly sensitive (Nantulya, 1995 and Van den Bossche *et al*, 1999).

The polymerase chain reaction (PCR) is highly sensitive and specific and has widely been used in detection of trypanosomes primers targeting sub group Trypanozoon (Moser *et al* 1989).

Result from PCR assays for T.vivax and T.evansi were combined with results from parasitological and serological assays to provide information on prevalence rates for the four

provinces from where the sample were obtained (Gonzales *et al* ,2003).

## **1.11 prevention and control:**

### **1.11.1 Chemotherapy:**

Chemotherapy is being widely used based on usage of various types of trypanocidal drugs. Most of these trypanocidal drugs have been in use for many years, their effectiveness has widely been reduced and trypanosomes develop what is known as drug resistance ( Luckins 1999, El Rayah 1992).

Trypanocidal drugs commonly used include, Homidium compounds (Ethidium and Novidium), Diaminazine aceturate (Berenil), Quinapyramine sulphate (Antrycide), Isometamidium chloride (Samorin) and Arsenical compounds (Cymelarsan).

Currently Diaminazene and Isometamidium are most widely used in cattle because they have no cross resistance, while equine and camels are treated with Quinapyramine (Kettle, 2000).

### **1.11.2 Vector control:**

In the absence of a vaccine for trypanosomosis and with the looming threat of further trypanocidal drug resistance the most theoretically desirable means is controlling of the vector population (Leak, 1999).

#### **1.11.2.1 Chemical control:**

There are several different control techniques available today, but in brief the common methods are spraying, whether

aerial, from the ground, of residual insecticides, such as organochlorines (DDT, Dieldrin , Endosulfan ), Pyrethroids (delta methrin, petmethrin ). Pyrethroids are preferred because they are rapidly degraded in soil and are environmentally safe, unlike organochlorines, carbamates and organophosphates that bioaccumulate in the food chain and are highly toxic to mammals and other vertebrates and insects (flora). Despite being effective, the use of organochlorines and organophosphates are now banned for wide spread outdoor spraying; susceptibility to insecticides varies from one species to another, and between the different classes of species (Leak, 1999). Although the process is highly labour intensive and limited in geographical scope, the spraying is administered discriminatively to day and night resting sites during the dry season and are much more effective than indiscriminate spraying from the air or from vehicles.

#### **1.11.2.2 Targets and traps:**

Traps and targets are mechanical devices used to reduce numbers, kill or weaken flies through insecticides or various trapping methods. The use of traps and targets to control flies populations have been successful primarily because flies require very little mortality pressure to bring about a reduction in population or eradication from an area (Weidhaas and Haile, 1978). The traps and target attract flies by taking advantage of their primary host-seeking behaviours, visual and olfactory

stimulation .The development of potent attractants in second-generation synthetic pyrethroid insecticides are making this form of central technique highly successful (Wall and Langly 1991).There are many prototypes of traps and targets customized to attract as many flies as possible in different ecological systems with strong emphasis on designs that are easy to duplicate and maintain locally . All aspects of these targets and traps, from their design and color to their strategic placement, are reliant on understanding of the biology behaviour and ecology of the various fly species.

#### **1.11.2.3 Bush clearing:**

Exploiting the knowledge that flies concentrated in certain areas lead to numerous bush-clearing projects all over West and East Africa to drastically alter and maintain the area unsuitable for fly habitation (Leak 1999). Bush clearing is unsuitable as a long term control measure due to expense and speed of reinvasion, as well as environmental damage it causes through soil erosion, decreased soil fertility and its adverse effects on water supplies (Morris, 1949).

#### **1.11.2.4 Sterile insect technique:**

One of the more modern methods of non-insecticidal control is the Sterile Insect Techniques (SIT) which was first considered as a means to sterilize flies by. This techniques relies on the mating of wild females with sterile male flies, thus resulting in no off springs. However SIT was considered to be impractical



for control of high density fly population. Sterilization of male flies can be carried out by:

Irradiation, Chemosterilization or Physiological sterilization (Rogers and Randolph, 1985).

## Chapter two

### Material and Methods

#### 2.1. Study area:

The study was carried out from February (2008) and continued for six months up to July (2008) at Nyala (South Darfur state ).The investigation area extended from the latitudes 12 °-14 ° N longitude 24° -25° E( Map 2) .The average rainfall in Nyala was 196,7 cm ( WFP. IDP Report South Darfur state 2002).

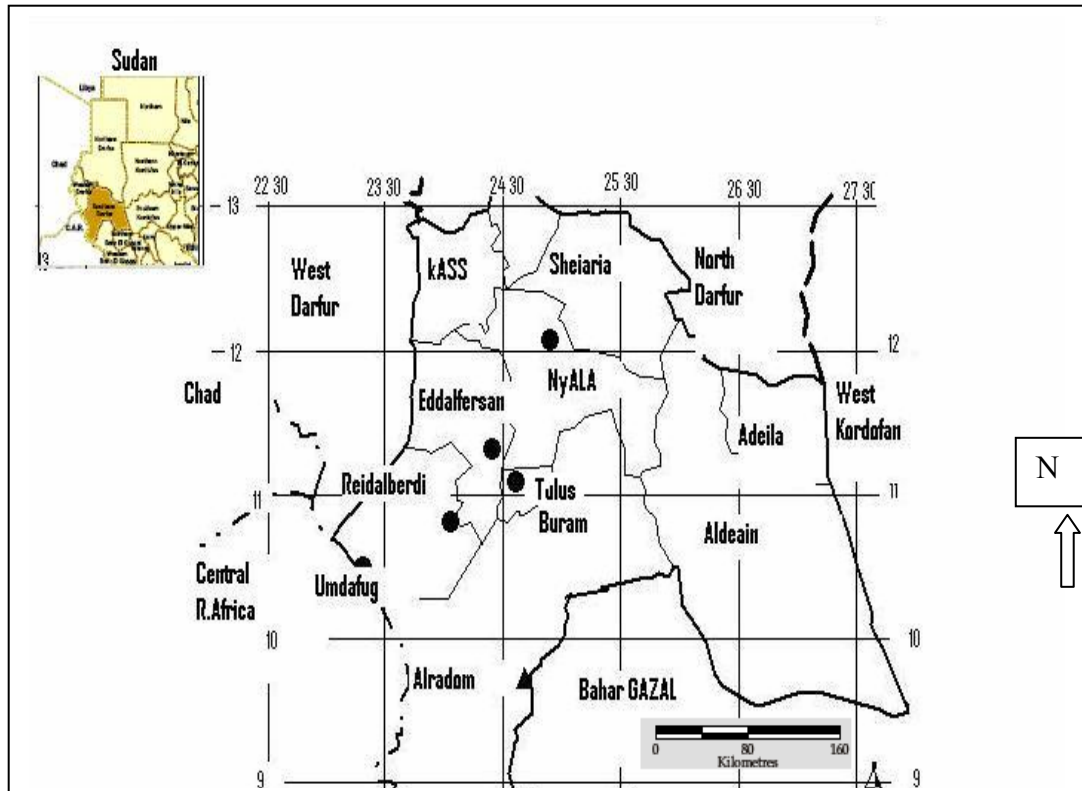
The climate of the State varies from the semi-desert climate in the Northern parts to rich woodland savannah in the Southern parts. The climate is *generally* dry and hot during summer (March –June). Warm to hot and wet during the rainy season (July-October). And moderately cool and dry during the cool season (November-February).

#### 2.2 Vegetation:

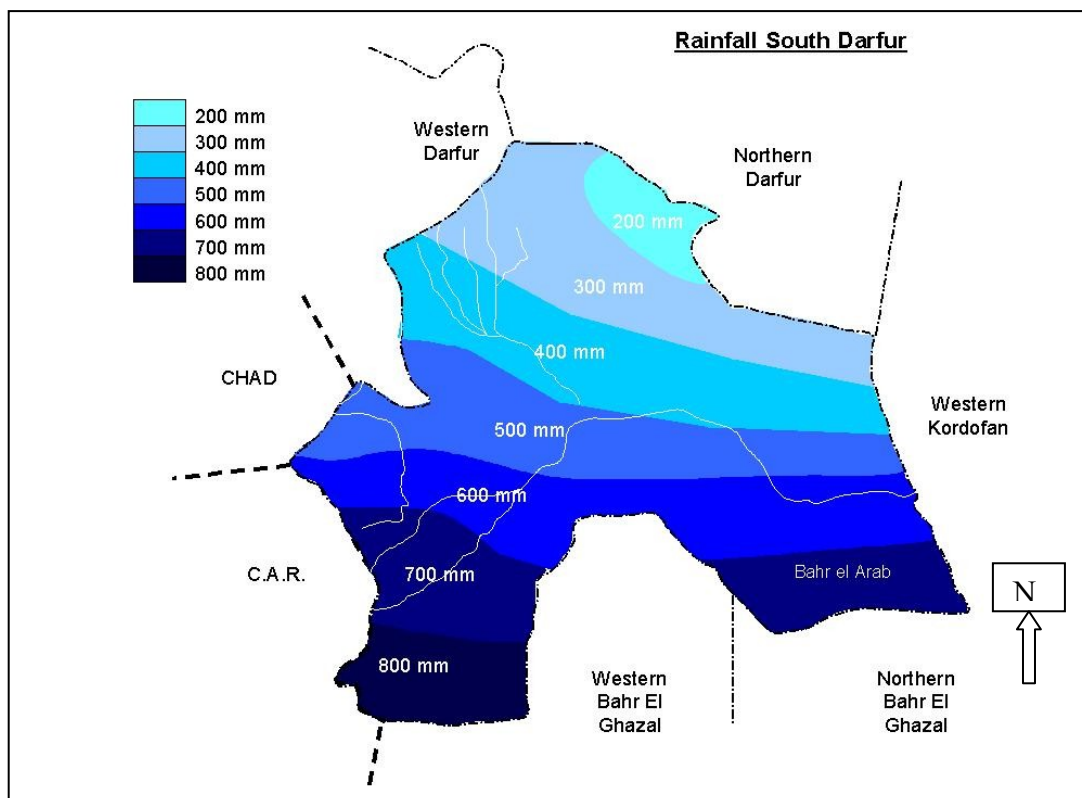
The main trees are *Adonsonia digitata* (Tabaldi), *Balanites aegyptiaca* (Hejleij), *Acacia nubica* (Laot), *Acacia seyal* (Taleh) *Acacia nilotica* (Garad), *Calotropis procera* (Ushar) ,*Scleocarya bivea* (Hammeid),*Acacia senegal* (Hashab). Other main plant and shrubs are *Cenchrus biforus* (Haskaneet). *khaya senegalensis* (Mahogany), *Anogeissus leiocarpus* (Sahab) *combrefcum spp.*(Habil) *ficus spp* (Gumez) , *Acacia mellifera* (Kitir) and *Tamarindus indica* (Aradeib ).

## **2.3 Rainfall:**

A rainfall map was downloaded from Almassar web site to illustrate the average annual rainfall through the State. (Map,3).



**Map (2) Study area in South Darfur state: (Political map. Modified from Web site. UN Office).**



**Map (3) Annual rainfall average in South Darfur State (Web site: Almassar)**

## **2.4 Flies in the area:**

Although Flies were not trapped, fly apparent densities were observed during the study period. This was conventionally graded as none where no flies were seen, low where few flies were seen occasionally and high when flies were seen all the time.

## **2.5 Camels sampled:**

Samples were collected from camels in Nyala locality, the main origin of these camels was North Darfur. They were forced to change the residence and pasture after the beginning of the conflict. The traditionally practiced migratory system in the past was changed to a semi -sedentary system.

The herd studied was included 100 head composed of 66 Female, 34 male. They were group into 3 age groups as follows:

Youngs	(1- 3 Years)	(15 female, 6 male)
Adults	(4- 6 Years)	(30 female, 12 male)
Old	(over 7 years)	(21female, 16male)
Total		(66 female, 34 male)

The survey started in February and March during the dry cool season (winter). In April and May the climate became hot (summer). In June and July the climate changes to the rainy season.

## **2.6 Clinical examination:**

The selected camels were labelled by ear tags and the samples collection which started in February (2008) continued at a bimonthly rate, and ended at the beginning of August (2008)

### **2.6.1 Blood films preparation:**

The skin over the Jugular vein was cleaned by 70% ethanol, a glass vacutainer with holder and two way needle was used, then 1ml of blood was drawn, the vacutainer tubes were labelled indicating date, number of animal, sex and age.

A drop of blood taken on a clean glass microscope slide spread by another slide was at an acute angle, air dried and fixed in absolute methanol for 2 minutes, the slides were labelled indicating date and animal number then kept in slide box and transferred to the laboratory for examination.

### **2.6.2 Giemsa stain:**

#### **2.6.3 Preparation of Giemsa stain:**

1- A volume of 54.0 ml glycerol was taken and placed in a clean round bottom flask container.

2-1.0 gm Merck Giemsa powder was added and heated to 60°C in a water bath clean glass beads were added.

3-The mixture was held at this temperature for one hour and shaken intermittently and allowed to cool at room temperature and 84.0 ml Methyl alcohol was added.

4-And left to stand at room temperature for 2 days, shaken regularly, then 0.2 gm Azur was added for every 100 ml prepared.

5-The mixture was left to stand for an additional 2 days at room temperature shaken regularly.

6-Filtered and stored in a dark bottle at room temperature.





Plate (1): Blood sample collection from a camel.

#### **2.6.4 Giemsa □ staining procedure:**

For use stock Giemsa stain was diluted in buffered distilled water (PH 7.2). Prepared blood smears were put in a staining jar containing Giemsa stain (10% concentration) and left for 30 minutes. Excess stain was washed with distilled water. After they were left to dry, stained slides were examined under Oil immersion at (10x100 magnification).

#### **2.7 Haematocrit centrifugation technique (HCT):**

Whole blood in anticoagulant (EDTA) was taken, and drawn in a Microhaematocrit capillary tube, one end was sealed with cristaseal and placed on a Microhaematocrit centrifuge. The tubes were then centrifuged for 5 minutes and placed on Mc Master slides chamber and the buffy coat was examined for the presence of the trypanosomes under a light microscope at 10x10 objective magnification (Woo 1970). The PCV was recorded for each animal by reading the values from the same tubes. Also leukocytosis were observed.

#### **2.8 Clinical signs:**

Clinical signs were observed daily for camels included in the study. They included general body condition, lymph nodes, nervous signs, and mucous membranes, abortion. The urine odour change was detected by experienced traditional herd healers.

## **2.9 Treatment:**

All camels found positive for T.evansi were treated with Quinapyramine sulphate which was injected by sub cutaneous route at a dose of 5ml per 300 kg body weight.

At the end of the study all animals injected with Quinapyramine chloride sub cutaneous route as a prophylactic measure.

## **2.10 Data analysis:**

Simple Arithmetic calculations of incidence rates percent were made. Descriptive information was given on clinical observations.

## **Chapter three**

### **Results**

#### **3.1 General observations:**

In the study area (Nyala locaillaty), there are poor roads especially in the rainy seasons and poor communications and transport due to insecurity it was therefore difficult to bring the veterinary services to the camels. The enforced sedentary system affected the normal condition of camels health, where over crowding led to increase in skin conditions (plate 2 and 3).

#### **3.2 fly densities:**

There were no flies observed during the dry season but they started to appear during the rainy season continuously ascending increasing in density during this season.

#### **3.3 Naturally infected camels:**

As illustrated in plates 4 and 5 camels naturally infected were highly debilitated, showing bony confirmation, loss of hair, nervous signs experienced as tendency to run astray hitting their heads against objects and trees.

#### **3.4. Number of animals infected:**

The results of investigations on camels' Trypanosomosis in Nyala locality were as follows:

A total of 100 heads of camels were examined during the different seasons in (2008). 28% camels were found positive for

T. evansi during the study period. No infection was detected during the cool season. By sex there were 12 (12%) males and 16 (16) females infected during the dry and wet season (April to July), (Table 2).

By age groups 7 young, 10 adult and 11 old were infected (Table 3). No infections was found among camels during the cool season, 7camels were found infected in the dry season and 21 in the rainy season (Table No.4).

Table (2) T. evansi infection rates using blood examination in the two sexes:

Sex						Total
Male (34)			Female (66)			100
Month	No.	+ve(%)	Month	No.	+ve(%)	+ve (%)
February	0	0%	February	0	0%	0.00 0.00%
March	0	0%	March	0	0%	0.00 0.00%
April	1	2,8%	April	1	1,5%	2 2%
May	4	11,7%	May	1	1,5%	5 5%
June	5	14,9%	June	4	6,06%	9 9%
July	2	5,8%	July	10	15,15%	12 12%
Total	12	35,3%	Total	16	24,25%	28 28%



Plate .2



Plate .3

Plates (2&3): camels suffering from poor condition in the study area.





Plates .4



Plates .5

Plates (4&5): camels found infected with natural *T.evansi*



### **3.4.1 Clinical manifestation:**

In infected camels the most eminent clinical signs observed were poor body condition, rough coats, emaciation, pale mucous membranes and enlargement in cervical lymph nodes (plates 4 and 5). Nervous signs characterized by over excitement, bent neck and hitting the head against trees and other objects, change in urine odour was detected by experience of traditional herd healers. One infected female aborted.

Table (3) Infection rates in camels of different age groups:

Age							Total	
Month	Youngs (21)		Adult (42)		Old (37)		100	
	+ve	+ve%	+ve	+ve%	+ve	+ve%	+ve	+ve%
February	0	0%	0	0%	0	0%	0	0%
March	0	0%	0	0%	0	0%	0	0%
April	0	0%	1	2,38%	1	2,70%	2	2%
May	0	0%	1	2,38%	4	10,8%	5	5%
June	2	9,52%	3	7,14%	4	10,8%	9	9%
July	5	23,80%	5	11,90%	2	5,40%	12	12%
Total	7	33,3%	10	23,80%	11	29,7%	28	28%

Table (4) T. evansi infection rates at different seasons:

Season	No. examined	No. infected	%
Winter (February-March)	100	0	0%
Summer (April-May)	100	7	7%
Rainy season (June-July)	100	21	21%
Total	100	28	28%

### **3.4.2 PCV values:**

PCV values for non –infected camels were between 31% - 23% while infected camels were 31%- 21% and became 27% - 14% when parasites were detected.

It was observed that PCV in infected animals declined in the beginning of the infection and improved after the treatment of animal and continued to increase after treatment.

The infection appeared when PCV was lowest although initial readings were high. Table (5). Leukocytosis were found in both infected and non-infected animals. Also increase of numbers of eosinophyls in infected and non-infected animals.

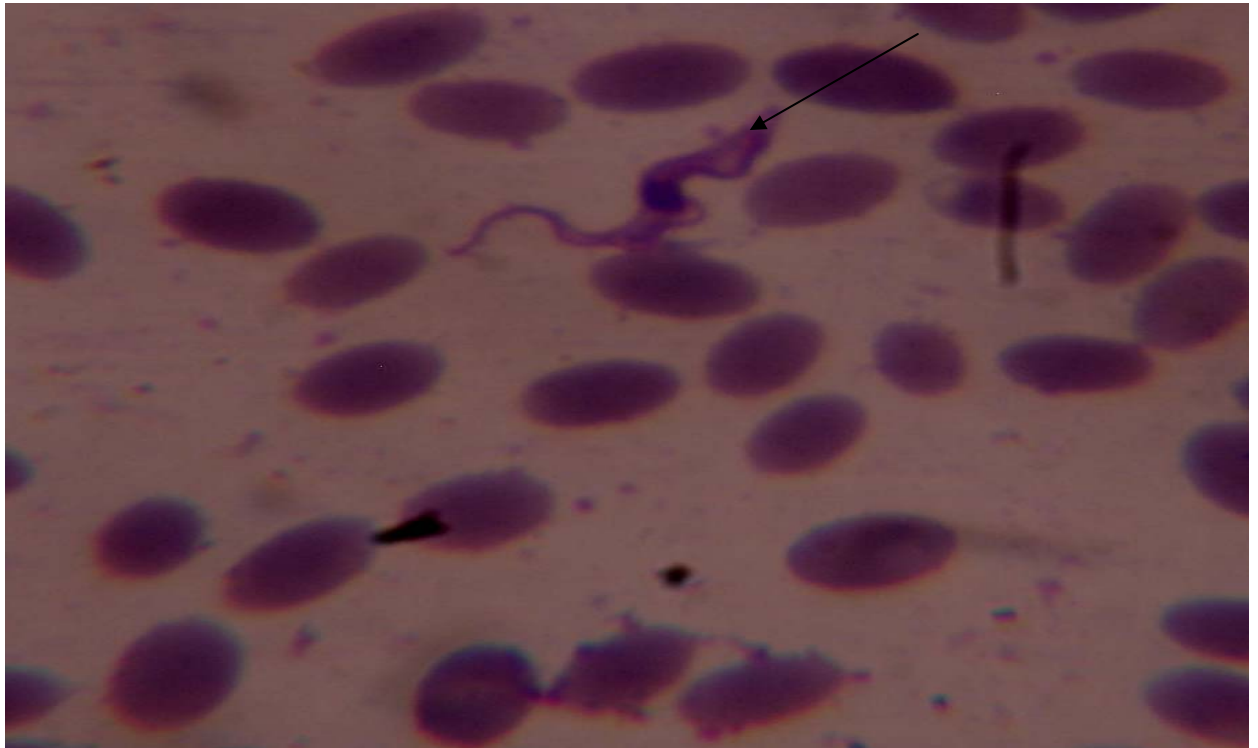


Figure (6) . *T.evansi* in blood of camel

Table (5): PCV in infected animal during the study period of 22 wks:

Date	February		March		April		May		June		July	
Animal infected	16/2 Day 0	29/2 2wks	15/3 4wks	30/3 6wks	15/4 8wks	30/4 10wks	15/5 12wks	30/5 14wks	15/6 16wks	30/6 18wks	15/7 20wks	30/7 22wks
1	31%	29%	28%	28%	28%	27%*	27%	28%	28%	29%	29%	29%
2	30%	30%	28%	29%	27%	24%*	26%	26%	26%	27%	28%	28%
3	25%	25%	27%	28%	27%	25%	22%*	22%	23%	24%	25%	25%
4	22%	24%	23%	22%	22%	20%	18%*	19%	21%	22%	24%	24%
5	28%	29%	28%	27%	25%	23%	21%*	22%	23%	22%	24%	23%
6	24%	26%	27%	25%	24%	22%	21%	20%*	24%	24%	25%	24%
7	28%	29%	27%	24%	23%	21%	19%	18%*	20%	22%	23%	23%
8	21%	25%	27%	26%	26%	26%	25%	26%	24%*	25%	25%	26%
9	25%	28%	29%	26%	24%	24%	22%	20%	20%*	22%	22%	23%
10	25%	23%	25%	24%	23%	23%	22%	20%	17%*	19%	22%	23%

11	28%	28%	27%	28%	26%	25%	23%	22%	21%*	22%	22%	23%
12	30%	30%	30%	29%	27%	25%	24%	23%	22%	20%*	24%	23%
13	23%	25%	25%	26%	25%	24%	24%	23%	22%	20%*	22%	23%
14	29%	31%	29%	27%	26%	26%	25%	20%	22%	21%*	22%	24%
15	25%	25%	28%	27%	25%	26%	25%	22%	17%	14%*	18%	22%
16	27%	27%	28%	26%	25%	24%	22%	21%	21%	20%*	22%	24%
17	25%	27%	27%	25%	23%	23%	21%	20%	20%	19%	17%*	20%
18	29%	29%	28%	26%	27%	25%	24%	23%	22%	22%	21%*	22%
19	25%	26%	25%	24%	24%	23%	21%	21%	21%	20%	18%*	21%
20	22%	25%	26%	26%	24%	23%	23%	21%	22%	21%	20%*	23%
21	26%	27%	29%	27%	25%	25%	24%	23%	22%	22%	21%*	25%
22	31%	30%	28%	29%	27%	26%	26%	24%	24%	23%	22%	22%*
23	29%	30%	29%	28%	27%	26%	24%	25%	22%	21%	19%	18%*
24	26%	28%	29%	28%	27%	25%	24%	24%	23%	22%	21%	20%*

25	25%	26%	27%	26%	24%	22%	21%	20%	20%	18%	17%	13%*
26	21%	24%	25%	26%	28%	25%	23%	24%	23%	22%	22%	21%*
27	27%	27%	26%	24%	23%	21%	21%	22%	21%	19%	18%	16%*
28	24%	24%	24%	24%	22%	24%	23%	22%	22%	22%	21%	20%*

\* Date of parasite detection.



## **CHAPTER FOUR**

### **DISCUSSION**

This study aimed at knowing the seasonal incidence of Trypanosomosis in camels among the different age groups and sexes in the study area of south Darfur. The impact of war on normal camel migration was also observed.

As a result of civil war changes were noticed on the livestock movement as they were restricted in one place in stead of the traditional migratory system. The general situation of insecurity compelled camels to stay in a limited area. The consequences are that services were inadequate during the dry season and veterinary services during the whole period especially the rainy season, this is supported by Lina (2008) in west Darfur who observed deterioration of veterinary services as a result of war in west Darfur.

These changes in the life patterns lead to poor preventive practice, pasture and water during the dry season. Also the sedentary system lead to appearance of wide spread of parasitic diseases.

Tree cutting is expected to lead to desertification in the area in the future, as wood is used for fuel and the dry leaves are left for the animals. This impacted animal health by reduction of shade and trees for browsing.

Infection rates in camels were higher during the rainy season (May – July), which was related in this season to the increasing abundance of Tabanid flies in the area.

In this study 28% camels were found infected based on results of the presence of the parasite in their blood smears, PCV was noticed to decline following appearance of the parasite. All infected camels were treated and did not get reinfected.

Camel owners used drugs randomly without a clear plan for use because of absence of veterinary services in the area. The observation that infection of Trypanosomosis in camels can occur in the acute or chronic form (Boid *et al.*, 1986) and lack of successful treatment may lead to drug resistance.

The symptoms observed in the affected animals are characteristic of the chronic form. Leukocytosis observed in this outbreak is a common finding in trypanosomosis (Yagoub, 1989; Karram *et al.*, 1991). However, Leukocytosis was due to increase of lymphocytes and monocytes. No apparent increases of eosinophyls or neutrophyls, as described by Karram *et al.* (1991) and Sergany *et al.* (1991) were found in the affected dromedaries.

There was a relationship between infection and low PCV. It was found that all infected camels showed lower PCV compared to uninfected camels. Previous authors have tried to determine values of PCV that can be used for diagnostic purposes. For example < 23% was proposed by Ngaira (2002), in Kenya, 20%

by (Chartier, *et al* 1986) and in Mouritana, and 18% by (Diall *et al* 1993) in Mali.

In this study PCV < 23 was recorded for positive animals, yet it was not possible to determine the lowest PCV as the condition differ according to age and general nutritional condition. Clinical signs observed in diseased camels during this study showed varying degrees of severity, which agreed with those described by Losos (1980), Soulsby (1982) Stephen (1986).

The infections in males were higher compared to females, because it is possible that males are used in travelling to the South to bring food, cutting trees and bring water. Also the infection rates in young camels were higher than old camels, this result disagreed with (Diall, *et al* 1993) and Jacquit (1994).

As reported by Dia *et al.* (1997), the prevalence of camel trypanosomosis increased with the age and decreased in older animals.

## **Conclusions:**

Livestock has been a critical livelihood resource and form of investment for virtually all livelihood groups in Darfur. Consequently livestock have been central to the many local tribal conflicts, in terms of livestock looting, migration routes, and grazing rights. Camels are the most important livestock for pastoralist livelihood. Without camel it is difficult to overcome the prevailing harsh environmental condition of the arid and

semi arid areas. In the area the abundant resources in pasture and water are available only in the rainy season.

T.evansi is present and widely disseminated in the camels in Nyala locality and sedentary system should be considered as the main risk factor for infection.

On the base of the conclusion above, here are the following the recommendation of this study:

- 1- When camels are to be treated, Consideration of the owners' diagnosis with respect to documented signs by the veterinarian is necessary. However a further comprehensive study on owner's diagnostic knowledge should be verified.
- 2- PCV could be used as indicator of infection, but consideration of other factors like age and sexes are necessary.
- 3- Extension camping are needed to advice camel owners on how to use drugs for prevention and treatment.

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4- Keeping camel herds under these conditions may lead to a gloomy end. So resuming the migratory life, which is one of the good reasons to install peace.

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## ملخص البحث

اجريت هذه الدراسة بمحلية نيالا حيث تقيم مجموعة من الرحل اللذين اجبرو علي الاستقرار بسبب النزاعات القبلية بالمنطقة هاجرت هذه المجموعة من موطنها الاصلي بشمال دارفور الي جنوبها هرباً من الوضع الامنى المتردى وحفاظاً على ممتلكاتها

هدفت هذه الدراسة الي توفير قاعدة من المعلومات عن (طفيليات المثقيات) مرض التريانسوما (الجفار) في الجمال بهذه المنطقة ،ايضاً معرفة موسمية المرض وعكس صورة عن تأثير الحرب بدارفور علي الرحل.

القطيع المستهدف 100 من الابل تحتوي علي 66 انثي و 34 ذكر ويشمل القطيع فئات عمرية مختلفة . اخذت العينات من هذا القطيع خلال 6 اشهر ( فبراير – يوليو ) اخذت العينات 1200 عينة خلال هذه الفترة لمتابعة حالة الحيوانات الصحية ومعرفة بداية ظهور الاصابة بمرض التريانسوما .

الوسائل التشخيصية كانت عمل مسحات من عينات الدم التي اظهرت وجود طفيل التريانسوما ايفانزاي وايضا تم عمل طرد مركزي لكريات الدم الحمراء وكان حجم تكدس كريات الدم الحمراء مختلفا بين الحيوانات المصابة وغير المصابة ، في المصابة يتدرج حجم تكدس كريات الدم الحمراء في الانخفاض الي ان يظهر وجود الطفيل في ادني مستوي للحيوان.

اظهرت النتائج ان هناك فرق واضح في ظهور الاصابة في الفصلين، لم تظهر اي نتيجة ايجابية في الفصل الجاف وبدأت ظهور النتائج الايجابية كانت منذ بداية موسم الامطار واستمرت النسبة في الزيادة الي نهاية الموسم

كانت نسبة الاصابة بالمرض 28% و في الذكور كانت الاصابة اعلي مقارنة بالاناث، لانها تستخدم في البحث عن الكلا والماء وقطع الاشجار مما يعرضها للدخول في المناطق التي بها الذبابة. قطع الاشجار كعشب للحيوانات و للوقود قد يودي الي الزحف الصحراوي في هذه المنطقة مستقبلا. كما ان نسبة الاصابة في الصغار كانت اعلي مقارنة بالاعمار الاخرى.

من الملاحظات ان اصحاب الابل لديهم معرفة جيدة بمرض التريبانسوما (الجفار) واعراضه ويعتمدون ايضاً علي التغير في رائحة البول في تشخيصهم ولكن درايتهم بطرق العلاج والوقاية ليست كافية.

اظهرت الحيوانات المصابة اعراض: ضعف عام في صحة الحيوانات ، تورم في العقدة اللمفاوية العنقية ، اعراض عصبية، شحوب في الاغشية المخاطية، تغير في رائحة البول بمساعدة اصحاب الحيوانات، حالة اجهاض. تم علاج جميع الحالات المصابة ولم تظهر اي مقاومة للعلاج.

توصى الدراسة بوضع معرفة الرعاية التقليدية في التشخيص في الاعتبار ،بالاضافة الي تكديس كريات الدم الحمراء في مقياس الاصابة نضع الاعتبار لعوامل اخري كالعمر والجنس. وعمل حملات ارشادية لتوعية اصحاب الحيوانات في كيفية استخدام الدواء، ووقف النزاع للحفاظ علي حالة الحيوانات الصحية.